

[43]31. An isolated and/or recombinantly produced *Dhh* hedgehog polypeptide, or a bioactive extracellular fragment thereof, encoded by a human *Dhh* gene.

[44]32. An isolated and/or recombinantly produced *Ihh* hedgehog polypeptide, or a bioactive extracellular fragment thereof, encoded by a human *Ihh* gene.

[45]33. The polypeptide of any of claims [41-44]29-32, formulated in a pharmaceutically acceptable carrier.

[46]34. The polypeptide of any of claims [41-44]29-32, wherein the polypeptide is purified to at least 80% by dry weight.

[47]35. An isolated nucleic acid encoding a polypeptide comprising a *hedgehog* amino acid sequence which is at least 95 percent identical to a *hedgehog* protein selected from the group consisting of SEQ ID No:16 and SEQ ID No:17, and fragments thereof, which *hedgehog* amino acid sequence (i) binds to a *patched* protein, (ii) regulates differentiation of neuronal cells, (iii) regulates survival of differentiated neuronal cells, (iv) regulates proliferation of chondrocytes, (v) regulates proliferation of testicular germ line cells, or (vi) functionally replaces drosophila hedgehog in transgenic drosophila fly, or a combination thereof.

[48]36. An isolated nucleic acid encoding a polypeptide having a *hedgehog* amino acid sequence encoded by a nucleic acid which hybridizes under stringent conditions to a nucleic acid sequence selected from the group consisting of SEQ ID No:7 and SEQ ID No:8, which *hedgehog* amino acid sequence of the polypeptide corresponds to a natural proteolytic product of a hedgehog protein and (i) binds to a *patched* protein, (ii) regulates differentiation of neuronal cells, (iii) regulates survival of differentiated neuronal cells, (iv) regulates proliferation of chondrocytes, (v) regulates proliferation of testicular germ line cells, or (vi) functionally replaces drosophila hedgehog in transgenic drosophila fly, or a combination thereof.

[49]37. The nucleic acid of claim [47 or 48] 35 or 36, wherein the *hedgehog* amino acid sequence is identical to a *hedgehog* protein selected from the group consisting of SEQ ID No:16 and SEQ ID No:17.

[50]38. An isolated nucleic acid comprising a coding sequence of a human *hedgehog* gene, encoding a bioactive *hedgehog* protein.

[51]39. An expression vector, capable of replicating in at least one of a prokaryotic cell and eukaryotic cell, comprising the nucleic acid of claim [47, 48 or 50] 35, 36 or 38.

[52]40. A host cell transfected with the expression vector of claim [51] 39 and expressing said recombinant polypeptide.

[53]41. A method of producing a recombinant *hedgehog* polypeptide comprising culturing the cell of [52] 40 in a cell culture medium to express a *hedgehog* polypeptide and isolating said *hedgehog* polypeptide from said cell culture.

[54]42. A recombinant transfection system, comprising

- (i) a gene construct including the nucleic acid of claim [47, 48 or 50] 35, 36 or 38, operably linked to a transcriptional regulatory sequence for causing expression of the *hedgehog* polypeptide in eukaryotic cells, and
- (ii) a gene delivery composition for delivering said gene construct to a cell and causing the cell to be transfected with said gene construct.

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[55]43. The recombinant transfection system of claim [54] 42, wherein the gene delivery composition is selected from a group consisting of a recombinant viral particle, a liposome, and a poly-cationic nucleic acid binding agent,

[56]44. A probe/primer comprising a substantially purified oligonucleotide, said oligonucleotide containing a region of nucleotide sequence which hybridizes under stringent conditions to at least 10 consecutive nucleotides of sense or antisense sequence of SEQ ID No. 7 or 8, or naturally occurring mutants thereof.

[57]45. The probe/primer of claim [56] 44, wherein the probe/primer further comprises a label group attached thereto and able to be detected.

[58]46. A test kit for detecting cells which contain a *hedgehog* mRNA transcript, comprising a probe/primer of claim [57] 45.

[59]47. A purified preparation of an antisense nucleic acid which specifically hybridizes to and inhibits expression of a gene encoding a human *Ihh* or *Dhh* *hedgehog* protein under physiological conditions, which nucleic acid is at least one of (i) a synthetic oligonucleotide, (ii) single-stranded, (iii) linear, (iv) 20 to 50 nucleotides in length, and (v) a DNA analog resistant to nuclease degradation.

[60]48. The preparation of claim [59] 47, which antisense nucleic acid is a DNA analog resistant to nuclease degradation.
